ON THE

SUCCESSFUL TREATMENT

OF

FLATULENCE

BY

A NOVEL USE OF CHARCOAL.

By ARTHUR LEARED, M.D., M.R.I.A.,

SENIOR PHYSICIAN TO THE GREAT NORTHERN HOSPITAL, AND PHYSICIAN TO THE ROYAL INFIRMARY FOR DISEASES OF THE CHEST.

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ON

FLATULENCE AND ITS SUCCESSFUL TREATMENT BY A NOVEL USE OF CHARCOAL.

The stomach and intestines always contain gases. They seem, both in a chemical and mechanical point of view, to be essential to digestion. A good deal of common air is swallowed with the food, and the remarkable facility with which air-bubbles are formed in the saliva is referable to this special purpose. It follows that oxygen and nitrogen are natural to the stomach, and it has been well ascertained that nitrogen is greatly in excess of oxygen, showing that even in the stomach this gas is in some way employed in the vital processes. But as gases are easily evolved by fermentation, and as saccharine and other fermentable matters dissolved in water are present in the gastro-intestinal tube, it results that its aëriform contents are far more complex. Perfectly healthy digestion probably does not admit of ordinary fermentation; but it is certain that a very slight defect in the process gives rise to it, and carbonic acid is then freely formed. Gaseous distension of the stomach and bowels thus becomes one of the most troublesome complications of dyspepsia. Carbonic acid, and more rarely sulphuretted hydrogen, known by the characteristic taste of the eructations, in the stomach, and these gases as well as carburetted hydrogen in the intestines, are the sources of trouble.

Two other causes of flatulence have been advocated, and the suddenness with which it is occasionally developed lends them some support. It has been supposed that gases are disengaged into the intestines and stomach from the blood in their capillary vessels. No satisfactory proof of this theory has been offered, and the gases of the blood do not bear the proper relation to those of the digestive tube to make it probable.

According to another view, a sudden relaxation of the abdominal muscles, as well as of the proper muscles of the stomach and bowels, permits an equally sudden expansion of gases that had been previously compressed within these hollow viscera. It

is true that gases being elastic, become under sufficient pressure greatly diminished in bulk, and that they expand in proportion when the pressure is removed. But to account for flatulent distension on this principle, an amount of pressure must be presupposed, which is *primâ facie* improbable. To test the matter, I tried the following experiment :—

A distensible india-rubber bag one inch and three-quarters in diameter, when filled, the sides being one-twentieth of an inch thick, was introduced into another bag of the same dimensions. A stop-cock was adapted to the inside bag, and both were then forcibly distended with carbonic acid introduced into the inner bag until the outer one measured three inches and two-thirds in diameter, when escape of the gas was prevented by turning the cock. The gas was thus, by the elasticity of the bags, subjected to a much higher pressure than any ever likely to be steadily exerted upon the contents of the gastro-intestinal tube. The outside bag was then removed by cutting, when, allowing for its thickness, the diameter of the sphere was found not to have enlarged in an appreciable degree. Here the removal of the outer bag represented a sudden relaxation of the gastric muscular force, and supposing the original pressure to have been only equal to what may occur in the stomach according to the theory in question, expansion of the gas was to be expected. But as no change resulted, I infer that no pressure can possibly be exerted on the gases in the alimentary cavities sufficient to produce by its withdrawal the phenomena of marked and sudden *flatus*.

The explanation of the sudden occurrence and disappearance of flatulence appears to me to be this :—If a bladder be half filled with air, and it be then compressed so as to accumulate all the air into one extremity, this last will assume the proper dimensions of the part. Now, we know that local and irregular contractions of the intestinal tube are not infrequent. The hour-glass contraction of the stomach is an example of it. In the spasmodic conditions which hysteria often presents, sudden contractions of parts of the alimentary tube occur, and the gas normally present in these portions being suddenly displaced, accumulates in the uncontracted parts. The result is precisely that described as occurring in the case of the flaccid bladder when compressed, the gases rushing from one part of the intestines into another, or from the small intestines into the stomach, cause sudden dilatation. The subsidence of compression in the one case as well as in the other, explains the equally sudden removal of distension.

When Physician to the Smyrna Hospital, during the Crimean war, I witnessed several cases in which distension of the digestive cavity was induced, apparently by the marvellous ingenuity of soldiers in feigning diseases. Several of our patients

became affected with "phantom tumours" of the abdomen. We never could altogether explain their production, but soon discovered a mode of dispelling them. When the patient was put under the relaxing influence of chloroform, the tumours invariably vanished without any appreciable expulsion of gas.

The relative amount of each gas in the alimentary tube greatly depends on the nature of the food, but nitrogen seems to be mainly the natural distending agent. Flatulence consists, then, in the exaggeration of a natural condition of which there is probably no normal standard, and it occurs in every degree up to complete distension. When far advanced, interference with the peristaltic motions of the tube, and therefore with digestion itself, ensues. The functions of adjacent vital organs also become seriously impeded by pressure, and dyspnœa, palpitation of the heart, or intermission of its action, result. If the muscular coats of the stomach and bowels are vigorous, the natural efforts are followed by expulsion of a portion of the gas, and this may generally be aided by stimulating remedies, carminatives, as they are called. But distension causes a temporary paralysis of these coats; and hence we are often told by patients suffering from this cause, that if they could "only get a little wind off the stomach much more would soon follow." The contractile power recovers itself as soon as the force which overpowered it is lessened.

The remedies for flatulence may be classified as follows into—

Those which prevent fermentation;

Those which favour the expulsion of gas;

Those which absorb gases.

The first and second need not at present delay us. Medicines are in common use for these purposes. Such is not the case with those intended to relieve tension by direct absorption of gas—a mode of treatment specially adapted to gastric flatulence. Indeed, I am not aware that any writer has advised medicines to be given with this special object.

Some time ago, I attended, with Mr. Spencer Wells, a case of albuminuria, with disease of the heart and other complications, in which flatulence was a most refractory symptom. The gentleman who was the subject of it often assured me that his other sufferings were trifling compared with what he endured from that cause. Unable to lie down at night, the day was miserably spent in search of even temporary relief. "Such," he would graphically say, "is my utter prostration, and at the same time horrible restlessness, that I feel like a worm that had been trodden upon." The usual stomach remedies, including charcoal-lozenges, were ineffective. It was then that the idea occurred to me that charcoal, administered in a new form, was a promising remedy. Charcoal is not unfrequently

prescribed in cases of flatulence, but the conditions necessary for success are not fulfilled. These are, that it shall be taken into the stomach dry and in a fresh state.

Some twenty-five years ago Dr. Belloc, a retired French officer, turned his attention to charcoal as a remedy for dyspepsia. He was himself a sufferer and had thus an opportunity of personally testing its action. He decided after many trials that charcoal made from poplar wood is the best. He found that the charcoal of some other woods caused a disagreeable taste in his mouth—even painful excoriations of the mucous membrane—thirst, and a pinching sensation at the pit of the stomach. He was in the habit of prescribing from two to six tea-spoonfuls, but says he has himself taken as much as 500 grammes—more than fifteen ounces in a day. The Académie Nationale de Médecine reported very favourably on a memoir Dr. Belloc published on the use of charcoal, and in France it soon became a favourite remedy. Its reputation spread to this country, and now we find charcoal lozenges, and even charcoal biscuits, sold as dyspeptic remedies.* Belloc's charcoal is in the form of a moist powder. He advised that it should be taken stirred up in water. In this country charcoal is occasionally prescribed in mixtures. The biscuits and lozenges must of course be thoroughly impregnated with saliva to enable them to be swallowed. Now, charcoal taken in any of the above modes always seemed to me of little efficacy. My device was to give the ordinary wood charcoal freshly prepared and hermetically sealed in gelatine capsules. Nothing could have been happier than their effect in the case I have referred to. Three or four capsules were sufficient to give complete relief each time. Nor is it often that the objective evidence of beneficial action is so plain. When the sound on percussion over the greater end of the stomach was quite tympanitic, this would completely subside into the ordinary clear tone of the part after the capsules had been swallowed a few minutes.

Encouraged by this ease, the capsules were given in many other instances with excellent results. A series of experiments were now commenced with a view to determine what kind of charcoal was best for the purpose, and whether the matter admitted of further improvement.

The power of absorbing effluviæ possessed by charcoal had been known for ages, but its action upon different gases was first tested by M. Lowitz towards the close of the last century. The subject was pursued by Count Morozzo and afterwards more fully by M. Saussure. He used boxwood charcoal exclusively in his experiments, and found that a single volume of

* Its qualities are lauded in an essay by Mr. Bell "On Vegetable Charcoal: its Medicinal and Economic Properties." Second Edition. Churchill, 1857.

it absorbed the gases which possess a present interest in the following proportions :—

Sulphuretted hydrogen	55
Carbonic acid	35
Oxygen	9·2
Nitrogen	7·5
Carburetted hydrogen	5
Hydrogen	1·7

The able researches of Dr. Stenhouse, published in 1855, greatly increased the interest in the subject. His experiments were mainly directed to the deodorizing qualities of charcoal, and he proved beyond question that its properties of destroying the smell of putrid animal or vegetable bodies depended, not, as had been previously supposed, on its antiseptic power, but on the very opposite quality of absorbing and oxidising effluviæ. Several others have since that time investigated this absorbent action, and Mr. Hunter has recently published an account of his experiments, showing the relative amount of various gases taken up by different kinds of charcoal.*

He found that charcoal made from cocoa-nut shells possessed most power, and deduced a general rule that charcoal made from the harder woods was much superior to that from the softer. It may be added here, that animal charcoal, so useful as a decolorising agent, is very inferior as an absorbent.

In my own experiments, the gases were collected by displacement in the usual way. By a simple arrangement, the amount of absorption was determined by the quantity of mercury which flowed into, and was retained in the vessel containing the gas, into which the charcoal had been introduced. As the experiments have had a practical aim, they differ in some respects from those conducted by the purely scientific chemists. The gases were not dried, since in the moist state they more closely resemble those of the alimentary cavities, and combinations of other substances with charcoal were tried in the hope of discovering a still more effective absorbent than simple charcoal. The experiments have been very numerous, but it has not been thought desirable to encumber the table with more than seem necessary to elucidate particular points ; and as the absorption of carbonic acid possesses by far the most interest, this has alone been given. The absorbent action was instantaneous, and about seven-eighths of the whole was completed within two minutes. The time allowed for each experiment was an hour, but absorption continues at a slow rate for many hours. To obtain good results the charcoal must be exposed to a high heat in a crucible, until gas no longer escapes ; and it would seem that charcoal newly made is superior to that which has been re-ignited.

* *Philosophical Magazine*, February, 1865

Table showing the Absorption of Carbonic Acid Gas by Twenty Grains of Different Kinds of Vegetable Charcoal.

	Experiment.	Mean.
Vegetable ivory nut in small fragments, freshly ignited ...	2·26 2·26 2·20	2·24
Vegetable ivory, finely powdered and freshly ignited ...	2·20 2·20 2·12	2·17
Vegetable ivory, freshly ignited and ammoniated	2· 1·92 1·94	1·95
Vegetable ivory, platinized (2 per cent.)	1.74	1·74
Vegetable ivory, freshly ignited, soaked in water	1·36 1·32 1·24	1·30
Vegetable ivory, freshly ignited, covered with a layer of water	0·0	0·0
Coquilla nut, freshly ignited	2·0 1·94 2·4	1·99
Cocoa-nut shell, freshly ignited	2·0 1·98 1·92	1·97
Acacia, freshly ignited	1·80 1·88 1·94	1·87
Peat, freshly ignited	1·80 1·66 1·82	1·76
Belloc's, freshly ignited	1·82 1·80 1·70	1·77
Belloc's as sold, without ignition	·68 ·66 ·66	·67

From this table the following deductions may be made:— Charcoal made from the most solid vegetable substances is greatly superior as a gas absorbent to that made from the lighter kinds, like Belloc's preparation; and that made from vegetable ivory is the best.

The absorbent power of charcoal is slightly weakened by pulverization, is much impaired by exposure to the atmosphere and damp, or by soaking in water, and is altogether impeded by being covered with water.

Charcoal, to be effective against gastric flatulence, must be introduced amongst the gases of the stomach in the same state as when fresh from the crucible. The means for effecting this, enclosing it in gelatine capsules, so that it may be set free in the stomach by solution of the gelatine, has been already described.

It may also be inferred that, as the absorbent action is protracted and is not destroyed by being wetted, charcoal may still prove beneficial when it has passed into the intestines.

Charcoal, by virtue of its porous nature, takes up gases mechanically as a sponge takes up water. Its capacity in this respect is in proportion to the number and fineness of its pores. Charcoal made from vegetable ivory or cocoa-nut shell is a compact, heavy substance, having a metallic lustre and ring, the pores being quite invisible.

This kind of charcoal, then, is best adapted to the present purpose. It should, in the first instance, be carefully prepared by sufficient ignition, and when about to be filled into the capsules should be powdered and re-ignited in a crucible. I have as yet no clinical experience of the ammoniated charcoal; but when the alkali is indicated it will probably be found the best. Charcoal impregnated with chloride of platina has been recommended as an absorbent by Dr. Stenhouse, but it did not answer my expectations.

An experiment conducted for me by Mr. Robbins, to whom I am indebted for much valuable aid, shows how necessary it is that good unsaturated charcoal should be used.

An iron bottle, to which a long tube of the same material was adapted, was filled with twelve ounces of ordinary medicinal charcoal and placed on a strong fire. A glass tube, tapered at the free end to a very small size, was adapted by means of india-rubber tubing to the free end of the iron tube. As soon as the charcoal ignited, gas began to issue from the glass tube and continued to do so for about two hours. It could be ignited, showing the presence of carburetted and other inflammable gases. It is possible that the excess of gas was partly due to the charcoal not having been well made, and it certainly shows the necessity for caution in selecting the article for use.

Charcoal always contains oxygen, because, when taken from the crucible, it immediately obtains it from the atmosphere, and its affinity for nitrogen is much less. It may here be remarked that this easy separation of its component parts goes to prove that the combination of oxygen and hydrogen in common air is purely mechanical.

Charcoal has a different point of saturation for every gas, but when filled with one or more it is still capable of absorbing other gases. Thus, coarse-grained charcoal saturated with ammonia takes up more carbonic acid than charcoal without ammonia; and the same charcoal when saturated with both takes up a larger quantity of sulphuretted hydrogen than of either. This is a valuable property where, as in the case of the intestinal cavity, the gases are various. Much is still to be learned about it; but

the reason why charcoal saturated by ammonia takes up carbonic acid so freely is plainly due to the formation of carbonate of ammonia. The impregnation of charcoal with oxygen has important therapeutic actions. It is this which renders it so valuable an agent in destroying the fetor of foul sores, and, when taken internally, of correcting any putrefactive tendencies; and it is also by virtue of this that sulphuretted hydrogen is not only absorbed but immediately decomposed.

The gelatine capsules employed are of two kinds—those ordinarily used for taking liquid medicines, and those made in separate portions which fit into each other; in either case care is taken that they be hermetically sealed with gum or liquid gelatine as soon as filled. The limit of size for the capsules must, of course, be determined by the individual capability of swallowing them. The largest contained only five grains of the light charcoal at first used, and found so efficacious in the case mentioned, but the same capsule will contain more than ten grains of the heavy kind; thus, a relative as well as an absolute advantage is gained, for the heavy charcoal possesses much higher absorbent powers.

Charcoal taken in large doses presents one great disadvantage: intestinal obstruction, as in the case of magnesia, has sometimes been the consequence. Now, the table proves that vegetable ivory charcoal freshly ignited is three times more effective than Belloc's damp charcoal. But this superiority must be still greater in consequence of the mixing with water preparatory to Belloc's charcoal being swallowed; and if it sink in the fluids of the stomach, which, should any be present, it inevitably will do in consequence of the saturation, its efficacy will be altogether destroyed. But granting that charcoal taken in the ordinary way has a certain absorbent power, a very large dose will be required to equal the activity of a single capsule of the heavy charcoal.

It may be objected that, although charcoal be swallowed in hermetically-sealed capsules, it must necessarily undergo liquid saturation as soon as set free in the stomach. But charcoal, not being easily wetted, will float on the surface of its contents; and to test its capability of absorption when in this position I tried the following experiment:—

Into a receiver containing carbonic acid a little warm water was introduced: a capsule of heavy charcoal was then put into the receiver. The gelatine having been dissolved by the water, its contents were set free in about a minute, and the charcoal floated on the water. Absorption now proceeded actively.

The number of capsules to be taken must vary with the greater or less severity of the flatulence, but three or four will generally be found sufficient. It is not advisable to drink while

swallowing them, but the process may be aided by eating a small piece of dry bread.

Twenty grains, or two capsules, of the vegetable ivory charcoal absorb more than two cubic inches of carbonic acid gas. If a greater effect be desired, and the dose be increased to four capsules, nearly five cubic inches will be taken up. Now, admitting that these effects are not quite so active in the stomach as they are in the experiments, there must still be absorption enough to give relief to the patient. The effect may at any time be tested and the repetition of the dose guided by percussion over the greater end of the stomach. More charcoal should be taken as long as the percussion sound is tympanitic.

The beneficial action of charcoal need not be confined to the human subject. I have suggested its use in appropriately-sized capsules for flatulence in horses, and also as a remedy for that frequently fatal distension of the first stomach from carbonic acid which occurs in cows after certain food, such as clover and potatoes, and hope soon to hear of their successful application.

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